Disorder Wetting in Thin Cu_3Au Films

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We present an x-ray scattering study of the order-disorder phase transition in thin epitaxial films of Cu_3Au on Nb buffer layers. The transition is of first order in bulk single crystals and governed by the disappearence of superlattice reflections in the x-ray diffraction pattern. At the surface of a single crystal, missing neighbors lead to a weakening of the long-range interactions, and the transition tends to be continuous.

Using highly brilliant synchrotron radiation as a probe, we determined the temperature-dependence of the superlattice reflections in our films. From those we derive order-parameter profiles, unambigously revealing the appearence of a disordered surface sheet below the transition temperature. The thickness of this disordered layer on top of the ordered film grows logarithmically with temperature, as expected for a wetting transition. However, the interfacial roughness between the ordered film and the disordered surface increases in an unexpected way. The roughening has no counterpart in the bulk. We ascribe this roughening to interactions of the order-parameter fluctuations at the surface with the growing interface. The second interface, the niobium substrate, tends to stabilize the order via epitaxial strain.